

CLAIMS

1. A lithographic projection apparatus comprising:  
a radiation system to provide a projection beam of radiation;  
a support structure to support patterning structure adapted to pattern the projection  
beam according to a desired pattern;  
5 a substrate table to hold a substrate;  
a projection system to project the patterned beam onto a target portion of the  
substrate; and  
an active reflector comprising  
a body member,  
10 a reflective multilayer, and  
at least one actuator controllable to adjust a surface figure of said reflective  
multilayer,  
wherein said actuator is operable to exert a force having a component in a direction  
parallel to the surface figure of said reflective multilayer and comprises an element of at  
15 least one of the radiation system and the projection system.

2. A lithographic projection apparatus according to claim 1, wherein said  
actuator is operable to apply force to said active reflector such that a force component in a  
direction perpendicular to the plane of said reflecting multilayer is less than 50% of a total  
20 force exerted by said actuator.

3. A lithographic projection apparatus according to claim 2 wherein said  
force component is less than 20% of the total force exerted by the actuator.

25 4. A lithographic projection apparatus according to claim 1, wherein said  
actuator is operable to apply force to said active reflector substantially only in directions  
parallel to the plane of said reflecting multilayer.

5. A lithographic projection apparatus according to claim 1, wherein said actuator is operative to apply a torque to said active reflector

5 6. A lithographic projection apparatus according to claim 5, wherein said actuator is operative to apply torques about a point in or near said reflective multilayer.

7. A lithographic projection apparatus according to claim 5, wherein said active reflector comprises at least one projection at a back side opposing said reflective multilayer and said actuator is mechanically linked to said projection so as to apply said torques on said active reflector.

8. A lithographic projection apparatus according to claim 7, wherein said actuator is mechanically linked to said active reflector in between two projections.

9. A lithographic projection apparatus according to claim 1, wherein said actuator comprises a piezoelectric actuator.

10. A lithographic projection apparatus according to claim 1, wherein said actuator comprises one of a pneumatic and a hydraulic actuator.

11. A lithographic projection apparatus according to claim 7, comprising at least two projections and wherein said projections further define walls of a cavity adapted to contain a fluid to exert one of a pneumatic and a hydraulic force on said projections.

12. A lithographic projection apparatus according to claim 7, wherein said active reflector comprises a plurality of projections arranged in a regular array.

13. A lithographic projection apparatus according to claim 1, wherein said active reflector comprises a plurality of actuators arranged in a regular array.

14. A lithographic projection apparatus according to claim 1, further comprising a sensor to detect aberrations in a radiation beam reflected by said active reflector and a control system responsive to said sensor to control said actuator to minimize said aberrations.

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15. A lithographic projection apparatus according to claim 14, wherein said sensor comprises an interferometer to measure the surface figure of said active reflector.

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16. A lithographic projection apparatus according to claim 15, wherein said sensing means comprises an interferometer functional at a wavelength of said projection beam of radiation.

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17. A lithographic projection apparatus according to claim 14, wherein said sensor comprises a wavefront sensor to measure the surface figure of said active reflector.

18. A lithographic projection apparatus according to claim 14, wherein said sensor comprises at least one strain gauge to detect a strain in said reflective multilayer of said active reflector.

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19. A lithographic projection apparatus according to claim 14, wherein said optical system includes a plurality of active reflectors, said control system is operable to control said plurality of active reflectors together to minimize wavefront aberrations in said optical system as a whole.

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20. A lithographic projection apparatus according to claim 1, wherein said projection beam comprises extreme ultraviolet radiation having a wavelength of less than 50 nm.

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21. A lithographic projection apparatus according to claim 20 wherein said extreme ultraviolet radiation has a wavelength between about 8 nm and about 20 nm.

22. A lithographic projection apparatus according to claim 21 wherein said extreme ultraviolet radiation has a wavelength between about 9 nm and about 16 nm.

23. A lithographic projection apparatus according claim 1, wherein the  
5 support structure comprises a mask table to hold a mask.

24. A lithographic projection apparatus according to claim 1, wherein the radiation system comprises a radiation source.

10 21. A device manufacturing method comprising:  
projecting a patterned beam of radiation onto a target portion of a layer of radiation-sensitive material on a substrate; and  
controlling an active reflector to minimize wavefront aberration in the patterned  
beam of radiation, wherein said active reflector comprises a body member, a reflective  
15 multilayer and at least one actuator controllable to adjust a surface figure of said reflecting multiplayer by exerting a force having a component in a direction parallel to a surface figure of the reflective multilayer and wherein said active reflector comprises an element of  
at least one of a radiation system to produce the beam of radiation and a projection system  
to project the patterned beam of radiation.

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22. A device manufactured according to the method of claim 21.